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## Hugo Hildebrand Hildebrandsson*

Professor Hildebrandsson, who died at Upsala on July 29th at the advanced age of 87, occupied during his official career an exceptional position in the meteorological world. He was professor of meteorology in the University of Upsala and head of the Meteorological Institute, which included an observatory but had no network of stations in the ordinary sense. Born at Stockholm on August 19th, 1838, he graduated in philosophy at Upsala in 1866, became assistant to A. J. Ångström, was lecturer on physics, then lecturer in meteorology and chief of the meteorological section of the observatory. He organised observations of the motion of cirrus clouds in Sweden, which soon extended to the whole of Europe, and, in 1896, to the whole globe. Meanwhile he was invited to a newly established professorship of meteorology with an institute which was independent of the Swedish meteorological service, and this gave him academic freedom and perhaps a bias towards world meteorology.

Hildebrandsson was especially fortunate also in his friendship and association with Léon Teisserenc de Bort, cadet of a wealthy French family, an enthusiastic meteorologist who had an observatory on land and, in conjunction with A. L. Rotch, a floating observatory at sea. This was the steam yacht "Otaria," transformed from a "fish carrier." The great but unfinished

* Abridged from a biographical notice by Sir Napier Shaw which is to be published in full elsewhere.

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work, *Les Bases de la Météorologie dynamique ; Historique, État de nos connaissances*, is an abiding memorial of this collaboration between Hildebrandsson and Teisserenc de Bort : it is a magnificent work which is altogether beyond the range of the ordinary meteorologist's ambition. Hildebrandsson's view of meteorology was essentially dynamic, the investigation of physical processes in the atmosphere, but in no limited manner ; the whole length, breadth and thickness of the atmosphere were included in the study, which was enriched by several original contributions from Teisserenc de Bort to the meteorology of the upper air. Hildebrandsson's work on clouds gave us the International Cloud Atlas ; next best-known is his work on centres of action in the atmosphere, five papers in the transactions of the Swedish Academy illustrated by tables and curves which suggest correlation coefficients. There is not much in Hildebrandsson's work which we ordinarily understand as theory ; he was disposed rather to observe the motion of the atmosphere and deduce therefrom the forces that are operating rather than to formulate the forces *a priori* and thence deduce a motion which may or may not be atmospheric.

Hildebrandsson was a very companionable man with a good deal of humour as well as dignity. He was associated for many years with the International Meteorological Organization, becoming a member of the Committee in 1891 and secretary from 1900 until he retired from his professorship in 1907. He received many honours, including the Symons Medal of the Royal Meteorological Society and the embroidered Velvet collar of the Swedish Academy of Sciences ; he was Knight of the Order of the North Star, Commander of the Order of Vasa and of the Danish Dannebrog, and officer of the Legion of Honour. After his retirement he continued his researches and his last communication was issued less than two years ago.

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## British Association for the Advancement of Science

Southampton Meeting, Aug. 26th to Sept. 2nd, 1925.

THE Meeting of the British Association for the Advancement of Science at Southampton this year, was one in which meteorology played more than its normal part, not so much in respect of the actual number of papers contributed in the sections, as in respect of the attention devoted to the subject by workers in other fields, in particular that of general physics. The principal reason for this was to be found, of course, in the fact that the Presidential

Chair of the Mathematical and Physical Section (Section A) was occupied by Dr. G. C. Simpson, F.R.S., Director of the Meteorological Office.

Dr. Simpson in his Presidential Address dealt with "The New Ideas in Meteorology," and general appreciation was expressed of his very clear exposition of the manner in which the modern meteorologist views the atmosphere and its structure and motion.

Dr. Simpson divided his address into four parts, each of them dealing with principles which, although not exactly new, had been appreciated even by meteorologists only in the last few years.

Dealing first with *Thermal Stratification of the Atmosphere*, he said that our knowledge of the temperature of the free air dated only from 1898, when Teisserenc de Bort introduced his *ballons sondes*. Since then observations had been made in all meteorologically important areas of the globe. The atmosphere, which itself is comparatively speaking an extremely thin film of air, is composed of two shells surrounding the earth, the troposphere below and the stratosphere above, with the extremely sharp surface of separation—the tropopause—between them. After a brief description of the distribution of temperature in the atmosphere, Dr. Simpson went on to discuss the question of entropy. Any mass of air retains its initial entropy, no matter what its position in the atmosphere is, unless heat is added or extracted by processes such as condensation or radiation, so that the air must always travel along a surface of equal entropy. These isentropic surfaces or strata therefore act like physical restraints to the air preventing vertical motion. It is only when this stratification is less pronounced, a condition which occurs when the lapse rate is great, that ascending currents take place and then generally with considerable violence.

Coming next to *Mechanism of the Atmospheric Heat Engine*, Dr. Simpson dealt with the problem of how the kinetic energy of the winds is derived from the solar radiation which falls on the earth. He pointed out that the essential difference between the old idea and the new one due to Margules, is that the two masses of air whose difference of temperature is the cause of the motion, never mix. In each mass there is different stratification of isentropic surfaces so that when the two masses are brought side by side the cold mass slowly pushes its way as a wedge under the warm air and its isentropic layers are lowered. Similarly the isentropic layers in the warm air are raised, but the surface of discontinuity between them, which may be likened to a geological fault, is a sliding surface, and no air crosses it. The energy of the winds is derived mainly from the readjustment of the centre of gravity of the air mass considered as a whole, although the latent heat of condensation provides some additional energy by supplying heat to the warmer air as it ascends the slope of the surface of discontinuity.

These *Surfaces of Discontinuity* would soon disappear on a stationary earth, but mathematical investigations of the conditions governing the air motion at surfaces of discontinuity, chiefly carried out by Helmholtz, Margules, V. Bjerknes, and Exner, have shown that on a rotating earth inclined surfaces of discontinuity could be found persisting sometimes for days, sometimes permanently. The angle which the surface makes with the horizontal depends on three factors, the latitude, difference in temperature, and relative motion of the warm and cold currents. According to Bjerknes, there are three permanent surfaces of discontinuity: 1. Between the troposphere and the stratosphere. 2. Between the trade and anti-trade winds. 3. The polar front. Besides these three there are now recognised a constant succession of temporary surfaces of discontinuity which form and pass away in our own latitudes. This was followed by a short summary of the recent investigations of these surfaces, especially by J. Bjerknes, Bergeron and Stüve.

Finally, Dr. Simpson discussed the *Origin and Structure of Cyclones*, commencing with a comparison between the old idea of a cyclone as a nearly symmetrical vortex and the complex structure of a cyclone as depicted by Bjerknes, who interprets cyclones as gigantic waves or breakers on the polar front. More and more are we being forced to recognise in cyclonic depressions the meeting place of polar and equatorial air, but the forces which bring these two masses of air into juxtaposition are still far from clear. Moreover, it has not yet been shown that the forces brought into play are of the right order of magnitude. In a rival theory, Exner considers that the cold air moving westwards in polar regions is deflected southward by Greenland and other land masses, forming tongues of cold air which act as barriers to the warm westerlies ; cyclones are formed in the lea of these barriers. There is probably some truth in both these theories, but both fail to the extent that they make cyclones phenomena of the lower atmosphere while we have good reason to believe that the stratosphere plays a large part in their formation. These new ideas of the mechanism of a cyclone have had a far-reaching effect on the practical applications of meteorology, but the problems awaiting solution are numerous and difficult, and Dr. Simpson appealed to the Universities for help in solving them.

It was a matter of general regret that, owing to circumstances arising just before the meeting, Sir Napier Shaw, F.R.S., was unable to be present. His important paper, on " Trigger Action in the Atmosphere," was read by one of the Secretaries of Section A, and an abridged account of the author's abstract follows :—

" In discussions of the transformations of energy in the atmosphere it is sometimes suggested in explanation of certain kinds of rainfall that there may be something in the atmosphere analogous to catalytic action by which the transformation is initiated and continued, although the energy which is transformed is not supplied by the initiating agent, but is derived from the interaction of the constituent parts of the rest of the atmosphere. One of the characteristic features of such a condition is the discontinuity between two states which differ only in the presence or absence of the ' catalyser ' or initiating agent.

" Assuming that the condensation of water-vapour to form rain is a consequence of the reduction of pressure, we recognise at the outset that the transformation of energy associated with rain is twofold in character. There is first the gravitational energy of the environment which forces some portion of the air to rise, and secondly there is the development, in the form of sensible heat during elevation, of what was originally latent in the vapour. The energy of the second kind operates to limit the reduction of temperature, by reduced pressure, to an amount much below that which would be consequent upon the same reduction of pressure if the air were dry, and thereby to maintain or even increase the amount of energy available in the environment for further automatic elevation.

" The development of ancillary energy in the environment in this way may be so great as to place the originally saturated air in a condition which, without unfairness, may be described as explosive ; and it is on that account that the name ' trigger action ' may be applied to it. The ancillary energy comes from the saturated air itself and the supply is limited by the amount of saturated air available. In a sense therefore the process is not exactly catalytic.

" The communication draws attention to the parts which are taken by the environment and the environed air respectively, in this explosive action, and illustrates the subject by examples derived from the exploration of the pressure, temperature and humidity of the air by sounding balloons, kites or aeroplanes. For this purpose the results of soundings are set out in certain new kinds of diagrams which, for the sake of reference, are called

'tephigrams' and 'depegrams.' A tephigram, like an indicator diagram, shows the properties of the environing air in a vertical section of the atmosphere referred to ($t$) temperature and ($\phi$) entropy as co-ordinates, with a background exhibiting the physical properties of saturated air; and a depegram shows the properties of the air in the same vertical section referred to the temperature of its dewpoint ($d$) and its pressure ($p$)."

Sir Gilbert Walker, F.R.S., presented a paper on "Seasonal Variations of Weather in the North Atlantic," which he summarised in the following terms:—

"Of the three well-established oscillations—that in the southern oceans, that in the N. Pacific, and that in the N. Atlantic—the last is largely independent of the other two. Many facts regarding it have been established, of which a summary is given in the paper, and the controlling factor appears to be the pressure distribution rather than the sea temperature; but the causes of the pressure variation are mostly still unknown. Hildebrandsson's theory that the conditions are controlled by the quantity of ice seems to present considerable difficulties."

In a paper on "Periodicities in the Weather," Mr. D. Brunt described recent work which is likely to have far-reaching consequences. In his own words:—

"The paper gives a discussion of the results derived from a periodogram analysis of twelve sets of meteorological data each extending over at least 100 years. The data used are temperature at London, Edinburgh, Paris, Berlin, Vienna, and Stockholm; rainfall at London, Edinburgh, Milan, and Padua; and pressure at Edinburgh and Paris. The periodograms are given in detail in a paper read at the Royal Society in June 1925.

"It is found that no periods over 10 years in length are common to all the records, but some short periods, of lengths between 13 and 60 months, occur in a number of temperature records, with sensibly the same phase. An 11-year period, which may be the sunspot period, occurs in the Edinburgh temperatures, but in none of the other records; though a period of between 22 and 23 years, which may be the double sunspot period, occurs in several of the records.

"It is considered improbable that these results can be utilised for forecasting the weather at any future time."

Among the other papers read in Section A, may be mentioned Mr. N. K. Johnson's paper on "A Study of the Vertical Gradient of Temperature in the Atmosphere near the Ground"; Professor Proudman's paper on "The Effects of Capes, Bays and Islands on Local Tides"; and Dr. A. T. Doodson's paper on "Tide-predicting Machines." There was also Sir Frank Dyson's contribution, "Fixing the Position of the Equator"; Professor W. F. G. Swann's paper, "An Attempt to detect Corpuscular Radiation of Cosmic Origin"; and Mr. W. J. Thorrowgood's paper, "Earth Currents due to Magnetic Storms." Dr. R. L. Smith-Rose read a paper on "The Study of Wireless Wave Fronts by Directional Methods," which had some points of contact with geophysics. Geology joined with physics in a discussion on "Variation in Gravitational Force and Direction, and its relation to Geological History."

There were a number of papers in other sections of the Association of interest to meteorologists as such, the one of most direct concern being a contribution by Professor W. M. Hobbs to

the programme of Section E (Geography), under the title, "The Source of the Cold Air of the North Polar Front." Professor Hobbs's contention is that Greenland is the main source of the cold air, a line of thought long since associated in this country with the name of Sir Napier Shaw. A glance through the daily time table revealed other papers with a meteorological bearing, including "Climate and Migrations in the Neolithic Age in Britain," by Mr. O. G. S. Crawford, before Section H (Anthropology); and "The Influence of Weather Conditions on the Growth in Diameter of Trees," by Mr. T. Thomson, before Sub-Section K (Forestry).

It is customary at meetings of the British Association to arrange a number of "Citizens' Lectures," at which members of the Association as such are not present. Residents in Southampton had the privilege of hearing Mr. C. J. P. Cave on the subject "The Highway of the Air," a lecture which he also delivered on another evening to the Citizens of Salisbury. Another Citizens' Lecture, that by Professor E. V. Appleton, was of geophysical interest. His subject was "The Rôle of the Atmosphere in Wireless Telegraphy."

Reports were presented by the Committees for the Investigation of the Upper Atmosphere, and for Seismological Investigations, both showing very healthy activity during the past year. Both committees asked for reappointment, and it is noted that the former intends to devote special attention to the very important subject of radiation.

On the lighter side may be mentioned an official excursion to the Royal Air Force Base at Calshot, by permission of the Air Ministry. Here demonstration flights by flying boats were given, and parties were conducted round the station, including a visit to the meteorological station. Afterwards an excellent tea was provided, and the whole party journeyed back to Southampton by boat in the way it had come, having spent a very enjoyable afternoon in very good weather conditions.

The Meteorological Luncheon was held again as in past years, and was a very successful function, bringing together in all 47 meteorologists and their friends. It was held at the South Western Hotel, and those present included:—

Dr. G. C. Simpson, F.R.S., President of Section A (in the Chair); Professor H. Lamb, F.R.S., President of the Association; Sir Frank Dyson, F.R.S., Astronomer Royal; Professor H. H. Turner, F.R.S., Mrs. and Miss Turner; Sir Gilbert Walker, F.R.S.; Mr. C. J. P. Cave, President of the Royal Meteorological Society, and Mrs. Cave; Professor J. W. Nicholson, F.R.S., and Mrs. D. Wrinch-Nicholson; Mr. F. E. Smith, F.R.S., General Secretary of the Association; Dr. Harold Jeffreys, F.R.S.; Dr. Vaughan Cornish; Professor W. G. W. Swann; Professor A. M. Tyndall, Recorder of Section A; Professor E. H. Neville, Mr. W. M. H. Greaves and Mr. M. A. Giblett, Secretaries of Section A; Professor H. Stansfield, Local Secretary of Section A; Dr. J. S. Owens and Mrs. Owens; Mr. D.

Brunt; Mr. N. K. Johnson; Miss E. E. Austin; Captain J. Durward; Professor E. L. Watkin; Mr. W. Parnell Smith; Mr. R. Casson; Miss A. M. Trout; Mr. J. J. Shaw; Mr. F. J. W. Whipple; Mr. R. S. Whipple; Mr. R. A. Fisher; Professor T. H. Havelock; Mr. W. Hall; Dr. H. Borns; Mr. P. Y. Alexander; Mr. O. G. S. Crawford; Mr. G. Merton and Mrs. Merton; Mr. W. C. Parkinson; Mr. H. Carroll; Mr. A. P. Jenkin; Mr. W. G. W. Mitchell; Mr. E. W. Bliss; Mr. J. S. Farquharson.

The Meteorological Office, Air Ministry, by request of the Council of the Association, and with the collaboration of the Signals Branch of the Air Ministry, again gave a demonstration of weather forecasting from broadcast data received locally by wireless. The demonstration was given in a room in King Edward VI. Grammar School, adjacent to the Reception Room, and in the same room there was a comprehensive display of meteorological instruments, diagrams and photographs. A "Local Daily Weather Report" was produced and copies posted each day in the various sectional meeting rooms. As was done on a previous occasion, at Hull, the morning's weather chart and forecast were reproduced on the back of the menu at the Meteorological Luncheon. The exhibit was very well attended indeed, the item which attracted perhaps the most attention being a wonderful set of stereoscopic cloud photographs taken from an aeroplane and presented to the Meteorological Office by Commandant J. Jaumotte, Director of the Belgian Meteorological Institute.

## OFFICIAL NOTICES

### Discussions at the Meteorological Office

THE series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office during the session 1925-26. The meetings are being held on alternate Mondays at 5 p.m. The subject arranged for the first meeting, which was on Monday, October 12th, was a paper by A. Defant, entitled *Die Schwankungen der atmosphärischen Zirkulation über dem Nordatlantischen Ozean im 25-jährigen Zeitraum* 1881-1905 (Geog. Ann. Stockholm VI 1924, p. 13). The discussion was opened by Mr. R. G. K. Lempfert, M.A.

The subjects for discussions for the next meetings will be :—

October 26th, 1925. *Die atmosphärischen Elektrizität über den Meeren.* By K. Kähler (Ann. Hydr., Bd. 52, p. 201). *Opener*—Mr. R. E. Watson, B.Sc.

November 9th, 1925. *The light of the night sky, its intensity variations when analysed by colour filters.* By Lord Rayleigh (London Proc. R. Soc. A. 106, 1924, p. 117). *Opener*—Dr. G. M. B. Dobson.

The dates for subsequent meetings are as follows :—

November 23rd ; December 7th, 1925. January 18th ; February 1st and 15th ; March 1st and 15th, 1926.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

## Crop-Weather Stations

ABOUT a year ago a scheme was instituted by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland acting in co-operation with the Meteorological Office. In connection with this scheme, two meteorological courses were held at Kew Observatory from September 28th to October 1st. The first course was for the benefit of those who had little previous experience of the work of a meteorological observer, the other course was arranged primarily for those who were more advanced. Observers from eleven stations attended the first course, and those from nineteen stations the second course. Three members of the staff of the Ministry of Agriculture and Fisheries were present.

These courses were followed by a Conference at the Meteorological Office in connection with the same scheme, at which Sir Napier Shaw took the Chair. Dr. B. A. Keen, Assistant Director of the Rothamsted Experimental Station, read a paper on "Agricultural meteorological work at Rothamsted, with special reference to Soil, Temperature and Drainage," and Mr. W. R. Black, Secretary of the Agricultural Meteorological Scheme, on "The Soil Evaporation Apparatus at Bangor." Other papers read at the Conference were : "Effect of Meteorological conditions on Plant Diseases," by Dr. E. J. Butler, of the Imperial Bureau of Mycology, Kew ; "Wind records and windmill investigations at Harpenden," by Mr. C. A. C. Brown, of the Institute of Agricultural Engineering, Oxford ; "Effect of length of Day on Plant Growth," by Mr. M. A. H. Tincker, of the Welsh Plant Breeding Station, Aberystwyth ; and "Effect of Weather on Crops at Aberystwyth," by Mr. M. G. Jones, of the same station.

## OFFICIAL PUBLICATION

The following publication has recently been issued :—

*A Barometer Manual for the Use of Seamen.* A text book of Marine Meteorology with an Introduction and Appendices (M.O. 61), Tenth edition.

Very few changes have been made in this edition.

# Correspondence

To the Editor, *The Meteorological Magazine*

## Totland Bay Rainfall

THE total rainfall for the 8 months, January-August, 1925, amounts to 24·15 in. During my 38 years of readings at Totland Bay this is the first time I have registered so great a rainfall for this period of the year. The nearest approach to it is 22·92 in. during the similar period in 1912. The average rainfall for these 8 months is 16·53 in. It has taken $4\frac{1}{2}$ years to make up for the deficit of the 1921 great drought, which began with February of that year, as the following table will show :---

| | Rainfall 1921-5. | Average Rainfall. |
|---|---|---|
| | in. | in. |
| February-December, 1921 .. | 11·49 | 26·38 |
| January-December, 1922 .. | 29·84 | 28·95 |
| January-December, 1923 .. | 30·73 | 28·95 |
| January-December, 1924 .. | 35·22 | 28·95 |
| January-July, 1925 .. | 19·29 | 14·08 |
| August, 1925 .. .. | 4·85 | 2·45 |
| Total .. | 131·42 | 129·76 |

JOHN DOVER.

*Aston House, Totland Bay, Isle of Wight. September 4th, 1925.*

## Extent of a Flash of Lightning

THE extent over which the force of a flash of lightning can be felt is a question which I do not remember to have seen discussed in the *Meteorological Magazine*. On Monday, August 10th, several thunderstorms passed over the north of Cornwall. I was away from home on that day and experienced a heavy thunderstorm at Wadebridge about the middle of the day, and a slighter one at Polzeath on the sea-coast not far from Padstow about 4 p.m. (summer time). On my return home to Bolventor on the edge of the Bodmin Moors in the evening, I was informed of a heavy thunderstorm which had occurred about 5.30 p.m. (summer time) in which one flash of lightning had struck the earth. Careful enquiry showed that a flash of lightning followed by a terrific peal of thunder had struck the ground in a marshy spot possibly about 200 yards north of the Vicarage. A hole was made in the ground the depth of which could not be exactly ascertained owing to the wet nature of the ground, and the grass was torn up and turned over as if by a spade. The tenant of the farm which is about 150 yards west from the spot saw what appeared to him to be smoke rising from the ground where the lightning struck. He himself received a shock, the effects

of which he felt at the back of his neck for a few hours afterwards. His daughter, who was close by in the cowhouse, came rushing out in great fear saying that she had received a blow on her legs. The lightning also struck another farmhouse situated about 250 yards north of the marsh, doing a little damage in breaking glass and tearing the plaster off the wall. The tenant, a young man, who was working in the yard was thrown over the wheelbarrow by his side. Careful enquiry leaves no doubt in my mind that all that I have described above was the result of the same flash of lightning, for the young man who was thrown over the barrow came running down within a few minutes to relate his experience to the other farmer, and both agree that in the storm there was no other flash of lightning which was near enough to cause damage. Perhaps others who have experienced severe thunderstorms may be able to give some information on this question of the extent over which the force of a flash of lightning can be felt.

ARTHUR S. RASHLEIGH.

*Bolventor Vicarage, Launceston, Cornwall. August 29th, 1925.*

## Frequency of Mammato-Cumulus Cloud

DURING the years 1903-1910 mammato-cumulus cloud was recorded at Epsom, Surrey, on 68 days, and from 1918-1924, in London, on 59 days.

The two periods thus give an annual average frequency of 8·5 and 8·4 days respectively. During 1918 the cloud was seen on only 2 days during the year, and in 1907 and 1924 on 14 days. The monthly frequency distribution was as follows:—

| Date. | Jan. | Feb. | Mar. | Apl. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1903-10 .. | 1 | 4 | 4 | 7 | 8 | 8 | 12 | 12 | 7 | 2 | 2 | 1 |
| 1918-24 .. | 0 | 0 | 1 | 5 | 9 | 9 | 16 | 9 | 3 | 2 | 3 | 2 |

From the point of view of distribution in time the hour of maximum frequency occurs at 15h., but there is a morning maximum at 11h., and another in the evening at 18h., these hours being common to both periods. The cloud was seen as early as 5h. 45m. on April 21st, 1923, and as late as 21h. on July 29th, 1903. On May 19th, 1923, it formed on three separate occasions during the day. From 1903-1910 rain fell at some period of the day in 81 per cent. of the cases of appearance of the cloud, thunderstorms occurred in 31 per cent. From 1918-1924 the figures for rain were 83 per cent. and for thunderstorms 27 per cent.

SPENCER RUSSELL.

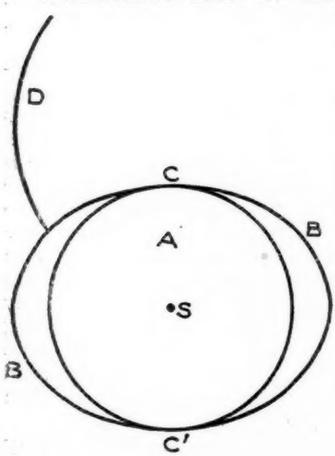
*September 25th, 1925.*

# NOTES AND QUERIES

## Notable Cloud Formations

Mr. Henry A. Rogers reports that at Bristol, on July 15th, at 4h. 30m., he saw a notable example of an eddy cloud, a long line nearly straight stretching from west to east horizon with front curled and with rear of stratus character. There was also a similar cloud but not so lengthy parallel to it. It drifted to the south-east, the sky in front being quite clear until sunset when the cloud developed into lenticular stratus. Mr. Rogers adds that on July 7th, 1922, he saw at Hastings the Noah's Ark cloud formation so much dreaded by the Orkney fishermen, a long line of cloud from south-east to north-west, the shape, of boat formation, pointed front and rear and full at the wide centre and throughout with cumulus, stratus and cirrus all curled and mixed. He was thus able to warn the Lifeboat people and the fishermen of the approach of one of the worst storms experienced in the English Channel in a July.*

## Remarkable Halo at Guernsey, July 3rd, 1925




The subjoined sketch illustrates a fine halo observed at L'Ancresse Bay, Guernsey, on July 3rd, 1925, from 10h. 30m. to 11h. G.M.T. S represents the sun. A was a dark circle representing the halo of 22°, B was an elliptical light arc; where it met A at C and C′ a vivid spectrum was noticed, the violet band being on the side towards the sun. D represents a portion of a larger arc, apparently with a radius of 90°; at its upper end this was lost in cirrus cloud and it was not visible within the halo.

The occurrence was recorded in the local press, with comments on its beauty and striking appearance, but without any attempt at exact description.

C. E. P. Brooks.

* See Meteorological Magazine, 57 (1922), 196.

## The Soaring Flight of the Albatross

It is well known that many birds are capable of remaining in the air for long periods without flapping their wings, or making any other obvious muscular effort. This soaring flight has been attributed to the support offered by rising currents of air. Such rising currents are formed where a horizontal wind strikes an obstacle such as a line of cliffs and is forced upwards, and it is especially near high cliffs with an onshore wind that soaring flight of this type can best be seen. In hot countries, as described by Dr. E. H. Hankin, birds are able to make use of the much weaker thermal ascending currents. Neither of these sources of support are available over the open sea, however, and yet birds such as the albatross are capable of soaring flight far from land. This problem has been investigated by M. Idrac* who made a voyage to South Georgia for the purpose. It had been suggested that the birds could make use of rising currents formed where the wind was blowing against waves which were moving with a different speed, but M. Idrac found that this explanation was not tenable, since soaring flight could take place with waves less than a foot high ; moreover the points selected by the birds for the beginning of their ascending flight, were not on the windward sides of the waves, but on the leeward, where the wind velocity was least.

The secret was revealed by means of studies with a moving-picture camera—the birds make use of variations in the speed of the wind. We may employ the analogy of a kite, which is supported by the upward thrust of a horizontal air current striking against the under surface of the material. The kite is held in position by a cord ; to make the kite rise higher, one holds the cord and runs against the wind. One could also maintain the kite by running with the wind, but faster than the wind is blowing. The albatross has no cord, and hence is blown along by the wind and in a uniform wind current it could not soar. If the wind increases it takes a few seconds for any body floating in the air to take up the new wind velocity, and during those few seconds the albatross can use its extended wings as a kite and soar upwards a few feet. Similarly, when the wind decreases, the albatross is for a few seconds travelling faster than the wind, and can again find support.

Over the sea with a steady wind, the variations of velocity at the same level are not often sufficiently great or regular for soaring flight, but a variation of a different nature is almost invariably present. Owing to friction, the speed of the air is relatively small just above the surface of the sea, and increases up to a height of thirty to fifty feet—a well-known fact.

* *La Nature*, Paris, 53 (1), 1925, p. 241.

Hence the albatross can always find a variation of wind velocity by changing its level. The procedure is roughly as follows; the bird is moving rapidly near the surface of the sea and therefore in a layer of low wind velocity. It turns head on to the wind, with its wings at an angle of about 55 degrees with the horizontal and the upward thrust of the wind raises it several feet. By the time the resistance of the air has reduced the bird's velocity to such an extent that the lowest air layer could no longer provide sufficient support, the bird has reached a higher layer and is therefore still moving fast enough into the wind to rise still further. In this way, always keeping head on to the wind, it rises to a height of thirty or forty feet. The change of velocity with height is now too small for it to soar higher, consequently it turns its back to the wind and begins to descend. Moving from a layer of greater to one of lesser wind speed, it is now overtaking the air, and can derive sufficient support during its descent for gravity to give it speed enough at the bottom of the curve to repeat the manœuvre. The whole operation takes about ten seconds and the albatross is in fact creating a series of artificial gusts of this period relative to itself sufficient to sustain it in the air without flapping.

Human gliding flight has hitherto made use only of ascending currents caused by obstacles in the course of the wind. The author considers that it may be possible to make use of thermal ascending currents, but he thinks that it is not practicable for human gliders to utilise the variation of wind velocity with height in the manner of the albatross, because the variation is rapid enough only in the lowest thirty or forty feet, and this does not provide sufficient space for manœuvring.

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## Trajectories of Upper Air Currents

DURING the summer of 1922 toy balloon " races " were arranged at Brighton by Major MacLulish, and prizes were awarded for long distance flights. At the suggestion of Mr. Hy. Harries, the date and time of release were inserted on the post cards carried by the balloons in the hope that interesting information might result from a study of the falling places of the balloons. Mr. Harries discusses some of the results in the *Meteorological Magazine* for March, 1923. The most interesting case was that of September 13th, 1922, when a depression was advancing south-east across the British Isles, " while 15 balloons were drawn into the cyclonic whirl, 5 were carried outside into north-eastern France."

From December, 1922, postcards were attached to the pilot balloons which are released daily at many meteorological stations

in this country and the results obtained during 1923 are discussed in *Professional Notes*, No. 42, which will be issued shortly.

The results obtained were rendered somewhat uncertain by reason of the fact that the balloons did not necessarily travel at any given height for any length of time, and it was suggested that if balloons could be made to drift along at a certain height useful information respecting the history of upper air currents might be obtained.

The following method of attacking the problem has been tried at Sealand, Chester. Two balloons are used; the first is inflated so that it just supports the weight of the second balloon uninflated, plus a length of connecting thread. The second balloon is then inflated until the whole system has the desired rate of ascent. The second balloon is burst when a certain height is reached and the first balloon then floats along at this height supporting the remains of the other. With regard to the methods of bursting the second balloon; over-inflation has been tried but is too uncertain; time fuses are somewhat uncertain and introduce a slight element of danger. The method which has been most successful is that in which a sharp point punctures the balloon at a definite amount of expansion which can be calculated with reasonable accuracy. The balloons carry post-cards and 10 of these have been returned. In 6 cases the bursting height of balloon No. 2 was observed; in the 4 other cases, the bursting height can only be given approximately.

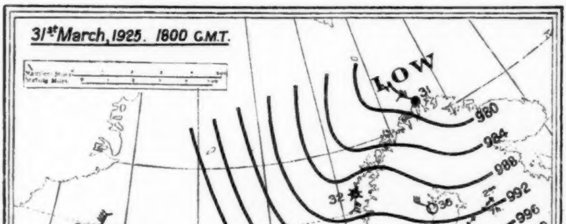
The first thing that strikes one is that the length of the flight and the duration of the flight have not been materially increased. With one exception, the times of flight are rather short—some definite ones being 55 min., 4½ hours, 5 hours, 5-6 hours, 7 hours, 8 hours, or about the same as is obtained generally by the use of one balloon. Apparently the leakage from the unburst balloon is sufficient to bring the whole system to earth in 5-6 hours.

Little can therefore be gained from a study of the above. In two high ascents, the resultant displacement is in accordance with the motion of the high cloud; in the lower ascents the surface pressure distribution is sufficient to trace the trajectory of the balloon with reasonable accuracy. In one or two cases, however, it would appear that the first balloon rose well above the "bursting height" of No. 2. In one case the bursting height is given as 100 feet but the height at which the balloon subsequently travelled seems to have been about 6,000 feet. This occurred in a showery or rainy westerly type of weather when a good deal of upward movement would be anticipated. It is thus unsafe to neglect the vertical component and treat the problem as a two dimensional one.

*A Long Flight.* Balloons were released at Chester at 16h. 30m.

on March 31st, 1925, and were found on April 2nd, 1925, in Estonia, a run of about 1,220 miles. This is the longest distance which a pilot balloon has been known to accomplish and implies a time of flight of 35-40 hours.

The synoptic chart for 18h. on March 31st, 1925, is reproduced herewith. The "crossed" line shows the path of the depression which travelled at an average speed of 38 m.p.h.; the dotted

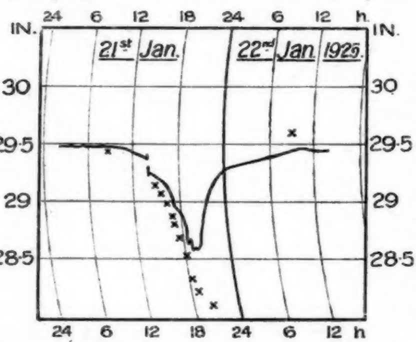



line indicates the probable path of the balloon. The speed with which the latter travelled has been reckoned about 32 m.p.h., but this may be rather low in view of the uncertainty of the wind velocity under rather rapidly changing pressure gradients. But the manner in which depression and balloon travelled in the direction and with the speed demanded by the isobars on the south side of the low (1,008 and 1,012 mb. isobars on 18h. chart) is rather striking.

J. DURWARD.

# Tropical Cyclone in Western Australia, January 21st, 1925

An interesting record of pressure changes during the passage of a tropical cyclone on January 21st, 1925, was secured at Roebourne, on the north-west coast of Western Australia. A definite cyclonic storm was first shown on the 9h. chart on January 20th, the centre being then located off the coast between Derby and Broome. During the next three days the cyclone moved slowly in a south-westerly direction, the centre passing Roebourne on the evening of the 21st. From the morning of the 22nd its intensity appears to have declined very rapidly, no definite centre being apparent by the morning of the 24th. During the 25th to 28th a depression passed eastwards to the south of the continent but there seems no sufficient reason for identifying this with the north-west cyclone.




In Fig. 1 a copy of the Roebourne baragraph trace is shown. The discontinuity at 14h. on the 21st is apparently due to a moving of the parts by the observer and a consequent reduction of the lag. The clock appears to have been about 2 hours fast. Fortunately, in addition to the barograph trace we have a series of barometer observations made by the observer at Roebourne at intervals during the approach of the cyclone centre. The barometer observations are indicated on Fig. 1 by the crosses. The record is remarkable both for the great fall of pressure and for the failure of the barograph, a small sized Richard instrument, to record it.

The radius of the central portion of the cyclone was unusually small. As a consequence the damage caused by it was confined to a relatively small area and the rainfall was nowhere excessive, the maximum being 4·76 in. at Abydos. At Roebourne every building is said to have been damaged and a portion of the jetty was carried away. Damage was also caused on some of the sheep and cattle stations between Roebourne and Fortescue on the coast to the south-west. Pearling luggers sheltering in the Cossack Creek near Roebourne experienced a rise of 20 feet in the level of the sea during the storm, some of the surrounding country being flooded.

The wind reached gale force at Roebourne at 15h., blowing in heavy gusts, and attained hurricane force from the south-east or south-south-east at 18h. The observer states that scud appeared to be travelling rapidly from both north-east and south-east at the same time during the storm. At 20h. 40m. a perfect calm occurred and lasted for 40 minutes. This was followed by a renewal of the hurricane with, if possible, increased violence, this time from the north-west. At 23h. 40m. this hurricane just as suddenly ceased.

E. Kidson.

## Health and the Tropics

Dr. Gerhard Castens, in the *Annalen der Hydrographie* for 1925, part 6, discusses the best ways of combating the ill-effects of tropical climate on health. He recommends full exposure to free-moving air combined with a temperate and active life and the fullest use of the diurnal variation of temperature ; he states that the bad reputation of tropical climates is a legacy of the old "whisky-colonial" days. The greatest enemy of health is the "sultriness" of the air, expressed by the saturation-deficit of air at the temperature of the body, and he measures this quantity in the open air, in thick-walled houses of the Arabian type, and in modern thin-walled bungalows with free ingress for the air. The modern bungalow with a wide verandah all round is found to be much better than the Arabian house, which greatly raises the sultriness and decreases the diurnal variation ; this type is in fact suitable for dry climates with a large diurnal range of temperature but not for moist uniform climates. He supports these conclusions by his experiences during the campaign in East Africa, when the health of the settlers who joined the forces greatly improved during the open air life on the march or in simple grass huts or shelters.

## Wind and Tide

Several references to the connection between wind velocity and the state of the tide appeared in the *Meteorological Magazine* during 1922. Sir Napier Shaw (in the February number) mentioned that Captain Hepworth used to insist that the weather changed with the tide ; Captain Brooke Smith in the next number stated that in many estuaries where there are sand or mud flats a variation of wind with tide was noticed by sailors ; and the May issue contained a communication from Mr. T. F. Twist giving particulars of some of the phenomena in connection with the wind and tide in the Bristol Channel above Minehead.

As a preliminary to a systematic investigation of the question the staff of the Meteorological Office at Holyhead was asked to

make an examination of the recorded wind speed in relation to the state of the tide. The records of a Dines pressure-tube anemometer were utilised; the times of high and low tide were extracted from the Admiralty Tide Tables, and the mean wind speed for the hour during which high or low tide occurred was set out under the two headings, day and night.

The preliminary investigation covered the month of April, 1923; the results showed that during this particular month the mean velocity of the wind at high tide was less than that at low tide by day but greater by night. The examination was therefore extended and the records for the year October, 1923, to September, 1924, analysed in a similar way. The means for each month were calculated; these are set out in the following table, in which the mean velocity derived from the tabulation of hourly readings for the whole of each month is also given.

HOLYHEAD: MEAN WIND VELOCITY IN MILES PER HOUR.

| Month. | | Day. | | Night. | | All hours. |
|---|---|---|---|---|---|---|
| | | High tide. | Low tide. | High tide. | Low tide. | |
| 1923 | October .. | 19·9 | 20·5 | 19·3 | 18·7 | 19·8 |
| | November .. | 19·2 | 19·3 | 19·4 | 19·9 | 19·1 |
| | December .. | 19·8 | 18·1 | 19·3 | 18·4 | 19·0 |
| 1924 | January .. | 16·9 | 18·1 | 17·4 | 17·4 | 17·3 |
| | February .. | 18·8 | 17·7 | 15·6 | 18·3 | 17·5 |
| | March .. | 13·1 | 11·5 | 9·4 | 10·3 | 10·9 |
| | April .. .. | 13·8 | 14·6 | 12·7 | 13·3 | 13·2 |
| | May .. .. | 15·5 | 14·7 | 13·6 | 13·3 | 14·1 |
| | June .. .. | 14·6 | 13·9 | 13·1 | 13·2 | 13·7 |
| | July .. .. | 15·3 | 16·1 | 15·2 | 13·7 | 15·1 |
| | August .. | 15·3 | 16·2 | 14·2 | 14·5 | 15·2 |
| | September .. | 17·8 | 18·5 | 17·1 | 17·2 | 17·9 |
| Mean for Year .. | | 16·7 | 16·6 | 15·5 | 15·7 | 16·1 |

Mean for high tide—16·10, for low tide—16·15.

It will be seen that the results arrived at fail to show up any connection between the state of the tide and the velocity of the

wind at Holyhead. The average wind speed at time of high tide appears to be identical with that at time of low tide and also with the general average so far as this station is concerned.

It will be interesting to see if similar results are shown in the case of other coast stations and especially at the mouths of rivers. It is unfortunate that there is no anemometer on the estuary of the Severn. Perhaps the most useful records for the present purpose will be those from the Lighthouse on the Maplin Sands at the mouth of the Thames.

## News in Brief

We regret to learn that Dr. James Niven, for many years Medical Officer of Health for Manchester, died in September at the age of 74, at Douglas, Isle of Man.

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Sir Gilbert Walker, F.R.S., will deliver a course of lectures on Dynamical Meteorology at the Imperial College of Science and Technology, South Kensington, on Fridays at 5 p.m., beginning on Friday, October 16th, and continuing to the end of March. The lectures will cover the ground dealt with by F. M. Exner in his book "Dynamische Meteorologie."*

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With reference to the heavy rainfall in the south of England on August 23rd mentioned on p. 200 of the September magazine, Capt. J. E. Cowper informs us that in the Isle of Wight 50·6 mm. (1·99 in.) were recorded on that day at Sandown, which is the heaviest 24 hour fall for nearly 20 years except for the fall on December 9th, 1914, when 63·8 mm. (2·51 in.) occurred. During the six days August 19th to 24th, 1925, 111·3 mm. (4·38 in.) fell at Newport, Isle of Wight.

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## The Weather of September, 1925

Throughout the month the weather was generally cool, unsettled and showery but with many bright periods. During the first few days the wind veered to between northwest and north followed by a marked drop in temperature after the warm weather experienced at the end of August. From about the 4th to the 12th, day temperatures remained for the most part below 60° F. in several districts with occasional ground frosts locally at night, the grass minimum temperature at Rhayader (Radnor) on the 12th being as low as 23° F. Rain fell frequently, though the amounts measured were often small. Thunderstorms occurred on several dates, sometimes accompanied by hail, while snow was reported to be lying on some of the Scotch mountains between the 4th and the 10th. On

* A review of this book is to be found in the *Meteorological Magazine* 60 (1925), 129.

the morning of the 11th the observer at St. Ann's Head (near Pembroke) reported the occurrence of a waterspout some five miles westward. It lasted seven minutes. Between the 11th and 15th the anticyclone centred to the south of Iceland moved slowly across the British Isles giving a few days' dry bright weather with a wider range of temperature but much mist or fog. After the 15th, secondaries associated with a depression spreading south from Iceland caused a renewal of unsettled and warmer weather. On the 19th one such secondary began to deepen rapidly near the north of the English Channel and became the dominant centre as it passed in a north-easterly direction across Great Britain. The wind rose to gale force on exposed parts of the southern and eastern coasts and heavy rain fell locally in the south-western and midland districts of England, *e.g.*, 55 mm. (2·18 in.) occurred at Filey, Yorkshire, and 46 mm. (1·83 in.) at Lincomb Lock (Worcester). Thunderstorms were reported from several places in the north and west on the 19th and in the south on the 21st. On the night of the 21st to 22nd a fresh depression caused very stormy weather on the Atlantic, the "Caronia" reporting force 10 (59 m.p.h.) at 1 a.m. Unsettled rainy weather continued until the 26th when a belt of high pressure spread across the southern districts causing quiet, fair and somewhat warmer weather there with much morning mist or fog. In the north the conditions remained cloudy with rain at times. The total rainfall for the month was more than twice the normal at several stations in the Midlands and south-west England and south-east Scotland, but in parts of western Scotland and south-east Ireland it was below normal, being as low as 58 per cent. at Fort William, Inverness.

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Pressure was below normal over northern Europe and Spitsbergen and also over the Atlantic between Newfoundland and the Azores, the deficit amounting to over 5 mb. in the southern part of Scandinavia and in Denmark. Over a belt extending from Greenland to south-west Europe, pressure was somewhat below normal. This distribution favoured north-westerly winds over the British Isles. Temperature was below normal generally, but as much as 7° F. in excess at Spitsbergen and slightly above normal in northern Scandinavia and the south of Spain. Rainfall was above normal in most countries, the excess being as much as 34 mm. at Spitsbergen. At the beginning of the month heavy rains in south-eastern Europe caused the Danube to rise much above its usual level at Budapest. Owing to the steady downpour which lasted several days in the neighbourhood of Hamburg, floods occurred on the Elbe and the Alster about the 9th. The crops suffered severely and many dykes gave way. Snow was reported to be covering the Alps in southern Bavaria down to

3,000 ft. on the 16th, and snowstorms have occurred in the Palatinate. Towards the end of the month heavy rain fell in Switzerland and floods occurred near Lugano and Locarno. In Sweden the rainfall was as much as 100 per cent. in excess in southern Gotaland, and in the coast districts of central Norrland. In the interior, however, it was below normal.

Unusually heavy rain in the Darjeeling district caused numerous landslips between Darjeeling and Siliguri about the middle of the month. On the 19th it was feared that crop failures were almost inevitable in parts of the Bombay Presidency and the Deccan owing to the lack of rain, but later in the month the rains became more normal over the whole of India. A typhoon swept across Kiushiu (Japan) and Fusan (Korea) on the 8th, causing many casualties and much damage, especially at Fusan. On the 20th, another typhoon, but of considerably less violence, passed over south-west Japan from Shikoku to Kiushiu. Extensive floods have occurred on the Yellow River (China) owing to the breaking of the dykes. Many people were drowned and the autumn crops destroyed. It is estimated that 2,000 square miles are under water.

The rainfall in Rhodesia was unusually early and heavy in the first part of the month.

Warm weather was experienced in most parts of North America during the first half of the month, temperatures of over 100° F. being recorded in the southern States. The cotton crop suffered from lack of rain early in the month but later rains revived the plants, though causing some damage to open cotton. Heavy snowfalls are reported in South America between Valparaiso and Mendoza.

In Australia the rainfall was generally about normal in Western Australia, South Australia and Queensland, but below normal in New South Wales and Victoria.

The special message from Brazil states that the rainfall was generally plentiful in the northern districts, being 38 mm. above normal, but irregular elsewhere, with an average 73 mm. above normal in the central districts and 2 mm. below normal in the southern districts. The Atlantic high pressure area withdrew eastwards during the month, while many secondary depressions passed across the country. There was a general improvement in the crops with the ending of the drought. At Rio de Janeiro pressure was 0·4 mb. below normal, and temperature 0·9° F. above normal.

## Rainfall September, 1925—General Distribution

| | | |
|---|---|---|
| England and Wales .. | 155 | per cent. of the average 1881-1915. |
| Scotland .. .. .. .. | 135 | |
| Ireland .. .. .. .. | 107 | |
| British Isles .. .. .. | 140 | |

## Rainfall: September, 1925: England and Wales

| CO. | STATION. | In. | mm. | Per-cent. of Av. | CO. | STATION. | In. | mm. | Per-cent of Av. |
|---|---|---|---|---|---|---|---|---|---|
| *Lond.* | Camden Square | 2·25 | 57 | 124 | *War.* | Birminghm, Edgbaston | 3·79 | 96 | 212 |
| *Sur* . | Reigate, Hartswood | 2·87 | 73 | 147 | *Leics* | Thornton Reservoir | 3·33 | 85 | 184 |
| *Kent.* | Tenterden, View Tower | ... | ... | ... | „ . | Belvoir Castle | 3·26 | 83 | 174 |
| „ . | Folkestone, Boro. San. | 2·24 | 57 | ... | *Rut* . | Ridlington | 3·15 | 80 | ... |
| „ . | Broadstairs, St. Peter's | 2·90 | 74 | 148 | *Linc.* | Boston, Skirbeck | 2·85 | 72 | 162 |
| „ . | Sevenoaks, Speldhurst. | 2·46 | 63 | ... | „ . | Lincoln, Sessions House | 2·58 | 65 | 167 |
| *Sus* . | Patching Farm | 3·76 | 70 | 115 | „ . | Skegness, Estate Office. | ... | ... | ... |
| „ . | Brighton, Old Steyne | 3·17 | 80 | 155 | „ . | Louth, Westgate | 2·34 | 59 | 116 |
| „ . | Tottingworth Park | 3·28 | 83 | 134 | „ . | Brigg | 2·71 | 69 | 160 |
| *Hants* | Ventnor, Roy. Nat. Hos. | 2·25 | 57 | 91 | *Notts.* | Worksop, Hodsock | 3·13 | 79 | 206 |
| „ . | Fordingbridge, Oaklnds | 4·18 | 106 | 194 | *Derby* | Mickleover, Clyde Ho. | 4·00 | 102 | 223 |
| „ . | Ovington Rectory | 3·69 | 94 | 161 | „ . | Buxton, Devon. Hos. | 5·64 | 143 | 174 |
| „ . | Sherborne St. John Rec. | 2·97 | 75 | 145 | *Ches.* | Runcorn, Weston Pt. | 4·56 | 116 | 171 |
| *Berks* | Wellington College | 2·99 | 76 | 163 | „ . | Nantwich, Dorfold Hall | 3·96 | 101 | ... |
| „ . | Newbury, Greenham | 2·96 | 75 | 147 | *Lancs* | Manchester, Whit. Pk. | 4·11 | 104 | 173 |
| *Herts.* | Bennington House | 3·26 | 83 | ... | „ . | Stonyhurst College | 4·59 | 116 | 120 |
| *Bucks* | High Wycombe | 3·20 | 81 | 169 | „ . | Southport, Hesketh | 3·73 | 95 | 136 |
| *Oxf.* | Oxford, Mag. College | 3·11 | 79 | 185 | „ . | Lancaster, Strathspey. | 4·26 | 108 | ... |
| *Nor* . | Pitsford, Sedgebrook | 3·08 | 78 | 171 | *Yorks* | Sedbergh, Akay | 5·02 | 127 | 120 |
| „ . | Eye, Northolm | 2·31 | 59 | ... | „ . | Wath-upon-Dearne | 2·27 | 58 | 144 |
| *Beds.* | Woburn, Crawley Mill. | 2·68 | 68 | 140 | „ . | Bradford, Lister Pk. | 2·65 | 67 | 128 |
| *Cam.* | Cambridge, Bot. Gdns. | 2·54 | 65 | 158 | „ . | Wetherby, Ribston H. | 4·03 | 102 | 224 |
| *Essex* | Chelmsford, County Lab | 2·26 | 57 | 131 | „ . | Hull, Pearson Park | 3·14 | 80 | 183 |
| „ . | Lexden, Hill House | 2·22 | 56 | ... | „ . | Holme-on-Spalding | 3·10 | 79 | ... |
| *Suff* . | Hawkedon Rectory | 3·33 | 85 | 173 | „ . | West Witton, Ivy Ho. | ... | ... | ... |
| „ . | Haughley House | 2·74 | 70 | ... | „ . | Felixkirk, Mt. St. John | 2·93 | 74 | 161 |
| *Norf.* | Beccles, Geldeston | 2·68 | 68 | 139 | „ . | Pickering, Hungate | 2·47 | 63 | ... |
| „ . | Norwich, Eaton | ... | ... | ... | „ . | Scarborough | 2·63 | 67 | 147 |
| „ . | Blakeney | 2·76 | 70 | 148 | „ . | Middlesbrough | 2·29 | 58 | 138 |
| „ . | Swaffham | 3·28 | 83 | 154 | „ . | Baldersdale, Hury Res. | 2·73 | 69 | 100 |
| *Wilts.* | Devizes, Highclere | 3·55 | 90 | 174 | *Durh.* | Ushaw College | 2·80 | 71 | 139 |
| „ . | Bishops Cannings | 3·37 | 86 | 154 | *Nor* . | Newcastle, Town Moor. | 3·62 | 92 | 177 |
| *Dor* . | Evershot, Melbury Ho. | 4·30 | 109 | 162 | „ . | Bellingham, Highgreen | 3·30 | 84 | ... |
| „ . | Weymouth, Westham | ... | ... | ... | „ . | Lilburn Tower Gdns. | 5·22 | 133 | ... |
| „ . | Shaftesbury, Abbey Ho. | 3·04 | 77 | 125 | *Cumb* | Geltsdale | 4·14 | 105 | ... |
| *Devon* | Plymouth, The Hoe | 3·53 | 90 | 144 | „ . | Carlisle, Scaleby Hall | 4·20 | 107 | 156 |
| „ . | Polapit Tamar | 4·08 | 104 | 146 | „ . | Seathwaite M. | 9·20 | 234 | 93 |
| „ . | Ashburton, Druid Ho. | 4·89 | 124 | 157 | *Glam.* | Cardiff, Ely P. Stn. | 5·36 | 136 | 173 |
| „ . | Cullompton | 5·03 | 128 | 224 | „ . | Treherbert, Tynywaun | 6·46 | 164 | ... |
| „ . | Sidmouth, Sidmount | 3·52 | 89 | 153 | *Carm* | Carmarthen Friary | 3·97 | 101 | 115 |
| „ . | Filleigh, Castle Hill | 5·47 | 139 | ... | „ . | Llanwrda, Dolaucothy. | 4·80 | 122 | 118 |
| „ . | Barnstaple, N. Dev. Ath. | 4·11 | 104 | 152 | *Pemb* | Haverfordwest, School | 3·79 | 96 | 107 |
| *Corn.* | Redruth, Trewirgie | 3·23 | 82 | 104 | *Card.* | Gogerddan | 4·92 | 125 | 135 |
| „ . | Penzance, Morrab Gdn. | 2·78 | 71 | 95 | „ . | Cardigan, County Sch. | 3·41 | 87 | ... |
| „ . | St. Austell, Trevarna | 4·33 | 110 | 136 | *Brec.* | Crickhowell, Talymaes | 4·60 | 117 | ... |
| *Soms* | Chewton Mendip | 5·05 | 128 | 164 | *Rad* . | Birm. W. W. Tyrmynydd | 4·93 | 125 | 128 |
| „ . | Street, Hind Hayes | 3·52 | 89 | ... | *Mont.* | Lake Vyrnwy | 4·81 | 122 | 136 |
| *Glos.* | Clifton College | 3·27 | 83 | 139 | *Denb.* | Llangynhafal | 4·93 | 125 | ... |
| „ . | Cirencester | 4·24 | 108 | 188 | *Mer* . | Dolgelly, Bryntirion | 6·09 | 155 | 143 |
| *Here.* | Ross, Birchlea | 3·78 | 96 | 197 | *Carn.* | Llandudno | 2·96 | 75 | 130 |
| „ . | Ledbury, Underdown. | 4·08 | 104 | 214 | „ . | Snowdon, L. Llydaw 9 | 13·17 | 335 | ... |
| *Salop* | Church Stretton | 3·62 | 92 | 178 | *Ang* . | Holyhead, Salt Island. | 3·59 | 91 | 134 |
| „ . | Shifnal, Hatton Grange | 3·56 | 90 | 184 | „ . | Lligwy | 3·40 | 86 | ... |
| *Staff.* | Tean, The Heath Ho. | 4·56 | 116 | 192 | *Isle of Man* | | | | |
| *Worc.* | Ombersley, Holt Lock. | 4·02 | 102 | 227 | | Douglas, Boro' Cem. | 4·00 | 102 | 121 |
| „ . | Blockley, Upton Wold. | 4·00 | 102 | 190 | *Guernsey* | | | | |
| *War.* | Farnborough | 4·45 | 113 | 209 | | St. Peter P't, Grange Rd | 2·88 | 73 | 111 |

## Rainfall: September, 1925: Scotland and Ireland

| CO. | STATION | In. | mm. | Per-cent. of Av. | CO. | STATION. | In. | mm. | Per-cent of Av. |
|---|---|---|---|---|---|---|---|---|---|
| *Wigt.* | Stoneykirk, Ardwell Ho | 4·66 | 118 | 167 | *Suth.* | Loch More, Achfary | 11·61 | 295 | 202 |
| ,, | Pt. William, Monreith | 3·27 | 83 | ... | *Caith* | Wick | 3·47 | 88 | 139 |
| *Kirk.* | Carsphairn, Shiel | 5·89 | 150 | ... | *Ork.* | Pomona, Deerness | 3·49 | 89 | 120 |
| ,, | Dumfries, Cargen | 2·94 | 75 | 100 | *Shet.* | Lerwick | 3·74 | 95 | 124 |
| *Dum* | Drumlanrig | 2·34 | 59 | 79 | | | | | |
| *Roxb* | Branxholme | 3·58 | 91 | 160 | *Cork.* | Caheragh Rectory | 3·37 | 86 | ... |
| *Selk.* | Ettrick Manse | 4·28 | 109 | ... | ,, | Dunmanway Rectory | 3·14 | 80 | 77 |
| *Berk.* | Marchmont House | 4·69 | 119 | 195 | ,, | Ballinacurra | 2·34 | 59 | 93 |
| *Hadd* | North Berwick Res. | 4·42 | 112 | 211 | ,, | Glanmire, Lota Lo. | 3·03 | 77 | 108 |
| *Midl* | Edinburgh, Roy. Obs. | 4·39 | 111 | 240 | *Kerry* | Valencia Obsy. | 4·02 | 102 | 97 |
| *Lan.* | Biggar | 4·36 | 111 | 191 | ,, | Gearahameen | 6·60 | 168 | ... |
| *Ayr.* | Kilmarnock, Agric. C. | 3·14 | 80 | 103 | ,, | Killarney Asylum | ... | ... | ... |
| ,, | Girvan, Pinmore | 4·37 | 111 | 114 | ,, | Darrynane Abbey | 4·76 | 121 | 134 |
| *Renf.* | Glasgow, Queen's Pk. | 3·39 | 86 | 122 | *Wat.* | Waterford, Brook Lo. | 2·64 | 67 | 95 |
| ,, | Greenock, Prospect H. | 3·88 | 99 | 82 | *Tip.* | Nenagh, Cas. Lough | 1·79 | 45 | 64 |
| *Bute.* | Rothesay, Ardencraig. | 4·31 | 109 | 106 | ,, | Tipperary | 2·84 | 72 | ... |
| ,, | Dougarie Lodge | 4·34 | 110 | ... | ,, | Cashel, Ballinamona | 2·33 | 59 | 95 |
| *Arg.* | Ardgour House | 6·35 | 161 | ... | *Lim.* | Foynes, Coolnanes | 2·64 | 67 | 95 |
| ,, | Manse of Glenorchy | 6·36 | 161 | ... | ,, | Castleconnell Rec. | 2·07 | 53 | ... |
| ,, | Oban | 4·25 | 108 | ... | *Clare* | Inagh, Mount Callan | 5·08 | 129 | ... |
| ,, | Poltalloch | 5·62 | 143 | 123 | ,, | Broadford, Hurdlest'n. | 2·51 | 64 | ... |
| ,, | Inveraray Castle | 5·76 | 146 | 90 | *Wexf* | Newtownbarry | 2·20 | 56 | ... |
| ,, | Islay, Eallabus | 5·22 | 133 | 125 | ,, | Gorey, Courtown Ho. | 2·94 | 75 | 119 |
| ,, | Mull, Benmore | 15·20 | 386 | ... | *Kilk.* | Kilkenny Castle | ... | ... | ... |
| *Kinr.* | Loch Leven Sluice | 3·21 | 81 | 125 | *Wic.* | Rathnew, Clonmannon | 2·73 | 69 | ... |
| *Perth* | Loch Dhu | 4·60 | 117 | 80 | *Carl.* | Hacketstown Rectory | 3·03 | 77 | 108 |
| ,, | Balquhidder, Stronvar. | 3·39 | 86 | 64 | *QCo.* | Blandsfort House | 2·60 | 66 | 96 |
| ,, | Crieff, Strathearn Hyd. | 2·90 | 74 | 101 | ,, | Mountmellick | 2·33 | 59 | ... |
| ,, | Blair Castle Gardens | 2·69 | 68 | 114 | *KCo.* | Birr Castle | 1·84 | 47 | 80 |
| ,, | Coupar Angus School | 3·20 | 81 | 161 | *Dubl.* | Dublin, FitzWm. Sq. | 2·18 | 55 | 114 |
| *Forf.* | Dundee, E. Necropolis | 2·92 | 74 | 140 | ,, | Balbriggan, Ardgillan | 2·53 | 64 | 124 |
| ,, | Pearsie House | ... | ... | ... | *Me'th* | Drogheda, Mornington | 2·64 | 67 | ... |
| ,, | Montrose, Sunnyside | 3·24 | 82 | 163 | ,, | Kells, Headfort | 2·88 | 73 | 108 |
| *Aber.* | Braemar, Bank | 3·37 | 86 | 134 | *W.M* | Mullingar, Belvedere | 2·73 | 69 | 102 |
| ,, | Logie Coldstone Sch. | 2·84 | 72 | 122 | *Long* | Castle Forbes Gdns. | 3·82 | 97 | 133 |
| ,, | Aberdeen, King's Coll. | 2·54 | 65 | 114 | *Gal.* | Ballynahinch Castle | 4·14 | 105 | 87 |
| ,, | Fyvie Castle | 4·26 | 108 | ... | *Mayo* | Mallaranny | 4·76 | 121 | ... |
| *Mor.* | Gordon Castle | 4·15 | 105 | 166 | ,, | Westport House | 2·76 | 70 | 78 |
| ,, | Grantown-on-Spey | 4·94 | 125 | 199 | ,, | Delphi Lodge | 6·74 | 171 | ... |
| *Na.* | Nairn, Delnies | 3·86 | 98 | 176 | *Sligo* | Markree Obsy. | 4·27 | 109 | 126 |
| *Inv.* | Ben Alder Lodge | 3·24 | 82 | ... | *Cav'n* | Belturbet, Cloverhill | 2·77 | 70 | 112 |
| ,, | Kingussie, The Birches | 2·58 | 65 | ... | *Ferm* | Enniskillen, Portora | 2·21 | 56 | ... |
| ,, | Loch Quoich, Loan | 9·00 | 229 | ... | *Arm.* | Armagh Obsy. | 2·62 | 67 | 107 |
| ,, | Glenquoich | 7·03 | 179 | 81 | *Down* | Warrenpoint | 3·38 | 86 | ... |
| ,, | Inverness, Culduthel R. | 4·07 | 103 | ... | ,, | Seaforde | 2·83 | 72 | 103 |
| ,, | Arisaig, Faire-na-Squir | 5·07 | 129 | ... | ,, | Donaghadee, C. Stn. | 2·98 | 76 | 125 |
| ,, | Fort William | 3·67 | 93 | 58 | ,, | Banbridge, Milltown | 3·01 | 77 | 122 |
| ,, | Skye, Dunvegan | 4·95 | 126 | ... | *Antr.* | Belfast, Cavehill Rd. | 4·55 | 116 | ... |
| ,, | Barra, Castlebay | 2·83 | 72 | ... | ,, | Glenarm Castle | 3·99 | 101 | ... |
| *R&C* | Alness, Ardross Cas. | 2·62 | 67 | 90 | ,, | Ballymena, Harryville | 4·63 | 118 | 149 |
| ,, | Ullapool | 6·84 | 174 | ... | *Lon.* | Londonderry, Creggan | 4·83 | 123 | 146 |
| ,, | Torridon, Bendamph. | 7·04 | 179 | 101 | *Tyr.* | Donaghmore | 3·53 | 90 | ... |
| ,, | Achnashellach | 6·08 | 154 | ... | ,, | Omagh, Edenfel | ... | ... | ... |
| ,, | Stornoway | 3·88 | 99 | 98 | *Don.* | Malin Head | 2·93 | 74 | 112 |
| *Suth.* | Lairg | 2·54 | 65 | ... | ,, | Rathmullen | 4·47 | 113 | ... |
| ,, | Tongue Manse | 5·25 | 133 | 165 | ,, | Dunfanaghy | ... | ... | ... |
| ,, | Melvich School | 5·19 | 132 | 185 | ,, | Killybegs, Rockmount. | 4·71 | 120 | 102 |

# Climatological Table for the British Empire, April, 1925

| STATIONS | PRESSURE: Mean of Day M.S.L. | PRESSURE: Diff. from Normal | TEMPERATURE: Absolute Max. | TEMPERATURE: Absolute Min. | TEMPERATURE: Mean Values Max. | TEMPERATURE: Mean Values Min. | TEMPERATURE: Mean Values ½ max. and min. | TEMPERATURE: Mean Values Diff. from Normal | TEMPERATURE: Mean Wet Bulb. | Relative Humidity | Mean Cloud Am'nt | PRECIPITATION: Am'nt | PRECIPITATION: Diff. from Normal | PRECIPITATION: Days | BRIGHT SUNSHINE: Hours per day | BRIGHT SUNSHINE: Percentage of possible. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mb. | mb. | °F. | °F. | °F. | °F. | °F. | °F. | °F. | % | 0—10 | mm. | mm. | | | |
| London, Kew Obsy. | 1011·3 | −3·1 | 61 | 30 | 54·5 | 39·2 | 46·9 | −0·4 | 40·0 | 85 | 7·3 | 50 | +13 | 18 | 4·4 | 32 |
| Gibraltar | 1018·1 | +1·6 | 75 | 46 | 67·7 | 52·5 | 60·1 | −0·9 | 51·5 | 81 | 3·4 | 1 | −67 | 1 | ... | ... |
| Malta | 1014·4 | +0·4 | 77 | 52 | 65·2 | 56·0 | 60·6 | −0·3 | 55·7 | 79 | 6·3 | 7 | −15 | 5 | 7·0 | 53 |
| Sierra Leone | 1010·9 | −0·1 | 95 | 68 | 90·5 | 74·2 | 82·3 | −0·5 | 76·3 | 75 | 5·6 | 70 | −33 | 8 | ... | ... |
| Lagos, Nigeria | 1008·2 | −1·6 | 91 | 71 | 89·1 | 76·6 | 82·9 | +0·6 | 78·4 | 78 | 7·8 | 178 | +29 | 10 | ... | ... |
| Kaduna, Nigeria | 1011·3 | +0·6 | 99 | ... | 92·8 | ... | ... | ... | 72·0 | 58 | 1·0 | 43 | −41 | 3 | ... | ... |
| Zomba, Nyasaland | 1012·6 | +0·1 | 83 | 59 | 80·7 | 63·5 | 72·1 | +2·9 | ... | 90 | 8·9 | 144 | +47 | 24 | ... | ... |
| Salisbury, Rhodesia | 1012·8 | −0·5 | 80 | 49 | 76·9 | 56·9 | 66·9 | +1·0 | 61·7 | 74 | 4·3 | 53 | +27 | 12 | 8·3 | 71 |
| Cape Town | 1016·6 | +0·5 | 101 | 46 | 75·2 | 55·3 | 65·3 | +2·0 | 55·6 | 74 | 3·8 | 12 | −39 | 4 | ... | ... |
| Johannesburg | 1017·5 | +0·4 | 75 | 46 | 65·8 | 51·2 | 58·5 | −1·1 | 53·4 | 84 | 6·0 | 107 | +55 | 15 | 5·2 | 46 |
| Mauritius | 1015·6 | +1·6 | 84 | 66 | 81·3 | 70·2 | 75·7 | −0·1 | 72·9 | 74 | 5·9 | 263 | +149 | 18 | 7·8 | 68 |
| Bloemfontein | ... | ... | 78 | 45 | 71·3 | 51·0 | 61·1 | +0·3 | 55·6 | 89 | 5·5 | 82 | +28 | 14 | ... | ... |
| Calcutta, Alipore Obsy. | 1006·8 | +0·5 | 102 | 69 | 94·4 | 76·3 | 85·3 | −0·4 | 77·4 | 81 | 5·5 | 85 | +37 | 6* | ... | ... |
| Bombay | 1008·5 | −0·3 | 94 | 76 | 91·1 | 79·7 | 85·4 | +2·3 | 77·0 | 71 | 2·8 | 0 | −1 | 0* | ... | ... |
| Madras | 1008·2 | −0·2 | 98 | 74 | 93·3 | 77·6 | 85·5 | +0·2 | 78·7 | 73 | 3·9 | 1 | −12 | 0* | ... | ... |
| Colombo, Ceylon | 1009·3 | +0·2 | 91 | 73 | 88·3 | 75·7 | 82·0 | −0·6 | 78·5 | 73 | 7·7 | 405 | +206 | 14 | 7·3 | 59 |
| Hong Kong | 1015·1 | +2·4 | 81 | 52 | 70·0 | 61·8 | 65·9 | −4·9 | 62·1 | 81 | 8·1 | 201 | +66 | 11 | 3·7 | 29 |
| Sandakan | ... | ... | 90 | 74 | 87·2 | 75·3 | 81·3 | −0·9 | 77·8 | 82 | ... | 209 | +103 | 10 | ... | ... |
| Sydney | 1020·6 | +2·0 | 84 | 51 | 74·0 | 58·4 | 66·2 | +1·6 | 60·1 | 72 | 4·9 | 53 | −82 | 14 | 6·3 | 56 |
| Melbourne | 1021·4 | +2·0 | 88 | 44 | 70·7 | 52·1 | 61·4 | +1·9 | 54·5 | 67 | 6·4 | 38 | −19 | 9 | 6·2 | 55 |
| Adelaide | 1021·3 | +1·5 | 92 | 45 | 74·6 | 54·4 | 64·5 | +0·7 | 55·3 | 52 | 5·4 | 27 | −19 | 8 | 6·5 | 59 |
| Perth, W. Australia | 1020·1 | +1·6 | 88 | 44 | 75·2 | 56·6 | 65·9 | −0·7 | 58·8 | 63 | 4·5 | 12 | −28 | 7 | 7·6 | 67 |
| Coolgardie | 1019·0 | +0·5 | 97 | 41 | 78·4 | 54·4 | 66·4 | +1·3 | 54·4 | 52 | 2·2 | 83 | +59 | 6 | ... | ... |
| Brisbane | 1019·6 | +2·0 | 85 | 44 | 77·8 | 59·6 | 68·7 | −1·6 | 62·4 | 68 | 4·1 | 25 | −66 | 12 | 7·8 | 68 |
| Hobart, Tasmania | 1017·7 | +3·2 | 76 | 37 | 61·8 | 48·4 | 55·1 | 0·0 | 49·0 | 72 | 7·7 | 50 | +2 | 16 | 4·8 | 44 |
| Wellington, N.Z. | 1020·9 | +3·1 | 72 | 40 | 63·6 | 50·6 | 57·1 | +0·1 | 53·3 | 75 | 5·9 | 67 | −34 | 10 | 6·1 | 56 |
| Suva, Fiji | 1010·1 | −0·5 | 91 | 71 | 85·3 | 73·8 | 79·5 | +0·8 | 75·9 | 81 | 7·6 | 341 | +54 | 20 | ... | ... |
| Apia, Samoa | 1010·3 | +0·4 | 89 | 72 | 86·4 | 74·7 | 80·5 | +1·6 | 77·3 | 76 | 4·5 | 246 | −14 | 16 | 7·2 | 61 |
| Kingston, Jamaica | 1012·8 | −1·3 | 90 | 67 | 87·2 | 69·7 | 78·5 | +0·1 | 69·5 | 77 | 3·0 | 69 | +38 | 9 | ... | ... |
| Grenada, W.I. | 1013·1 | +0·5 | 88 | 71 | 85·1 | 74·0 | 79·5 | +0·7 | 73·9 | 70 | 5·4 | 14 | −46 | 9 | ... | ... |
| Toronto | 1017·4 | +1·9 | 79 | 25 | 54·3 | 36·1 | 45·2 | +3·8 | 39·7 | 68 | 3·5 | 33 | −28 | 6 | 8·2 | 61 |
| Winnipeg | 1016·3 | −0·7 | 71 | 24 | 54·7 | 34·9 | 44·8 | +7·0 | ... | ... | 5·4 | 28 | −10 | 9 | 7·0 | 51 |
| St. John, N.B. | 1014·6 | +1·0 | 64 | 22 | 46·9 | 31·2 | 39·1 | +0·1 | 33·2 | 73 | 5·8 | 77 | −12 | 10 | 6·1 | 45 |
| Victoria, B.C. | 1016·5 | −0·8 | 71 | 39 | 55·1 | 42·9 | 49·0 | +1·3 | 42·3 | 85 | 5·3 | 43 | −1 | 13 | 6·2 | 45 |

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. John, N.B. ........ | 1014·6 | + 1·0 | 64 | 22 | 46·9 | 31·2 | 39·1 | + 0·1 | 33·2 | 73 | 5·8 | 77 | — 12 | 10 | 6·1 | 45 |
| Victoria, B.C. ........ | 1016·5 | — 0·8 | 71 | 39 | 55·1 | 42·9 | 49·0 | + 1·3 | 42·3 | 85 | 5·3 | 43 | — 1 | 13 | 6·2 | 45 |

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.